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ABSTRACT

During the quarter covered by this report, the design of the Lincoln Training System-3 (LTS-3) Terminal System was completed and construction of a prototype unit begun. Four major hardware developments occurred: 1) An Image Systems, Incorporated Model 201 CARD Reader was converted into the LTS-3 audio-visual student terminal; 2) the first of five LTS-3 terminal interface links with the PDP-8/I computer was completed; 3) the author's audio-recording facility, permitting random access, recording, and playback, was developed; 4) a special step-and-retreat camera for the production of microfiche masters was procured. A simulator for the Lincoln Terminal Language was written on the IBM 360/67 computer and used to check out programs for the field tests at Keesler Air Force Base. Approximately 75% of the lesson material for these operations was completed; this material will be used for the initial field trial of the LTS concept. It covers one week each in the areas of electronics and air traffic control and consists of 2000 frames. Initial estimates suggest even slow students will complete the material quickly, thuse saving time at no loss of training quality. (Author/LB)

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ABSTRACT

During this quarter, the design of the LTS-3 Terminal System was completed and construction of a prototype unit was begun. A simulator for the Lincoln Terminal Language has been written on the Laboratory's IBM 360/67 computer and is being used to check out programs for the field tests at Keesler Air Force Base. Approximately 75 percent of the lesson material for these operations has been completed.

15 September 1971

F. C. Frick
Program Manager

Accepted for the Air Force
Joseph R. Waterman, Lt. Col., USAF
Chief, Lincoln Laboratory Project Office

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ORGANIZATION

EDUCATIONAL TECHNOLOGY PROGRAM

Program Manager

F. C. Frick

DIVISION 2

Technical Staff

Brown, J. R.
Butman, R. C.
Goodman, L. M.
Grossberg, M.
Harris, W. P.
Karp, D.
LaFrey, R. R.
Ruyle, A.
Selfridge, O. G.

Assistants

Gagnon, J. V.
Hallowell, L. F.
Pugh, Barbara K.
Sloane, Christine T.

Technicians

Delsie, J. V.
Edman, E. W.
Johnson, P. J.
Ritchie, J. R.

DIVISION 7

Technical Staff

DeSantis, F. G.
Ralowicz, E. D.
Sanderson, A. M.
Stuart, D. G.
Wright, S. H.

Assistants

Roberts, A.
Staffiere, A. R.

EDUCATIONAL TECHNOLOGY PROGRAM

I. EDUCATIONAL DEVELOPMENT PROGRAM FOR LTS

A. The Keesler Trial

At least 75 percent of the lesson material has been completed at the Keesler Technical Training Center (KTTC) for initial field trial of the LTS concept early next calendar year. These materials cover about one week each in the areas of basic electronics and air traffic control. There are roughly 2000 frames in all. Initial estimates suggest that even slow students will complete the material in less than the usual classroom time, a common result of individualizing instruction. It is expected that the field trials will demonstrate this time saving at no loss in level of training. A plan to test this hypothesis is being prepared jointly by KTTC and Lincoln Laboratory.

B. Educational Techniques

The effort in developing new educational techniques has been concentrated during the quarter in providing Lincoln Terminal Language (LTL) programs to support the Keesler Trial. The LTL has been designed to interpret student responses and branch to new frames accordingly. Five LTL programs have been written, each designed to meet the needs of the Keesler authors. One program, for example, evaluates the outcome of several multiple-choice questions as a unit or "test." Another program interprets calculated numerical responses; different branches are taken for an error in the choice of unit of measurement, an error in location of the decimal or in numerical value, or for a totally correct response. Other LTL author programs deal with matching several choices from a set, and similar problems.

The branching logic is controlled for each frame by a list of parameters set by the author. One parameter assures that the correct LTL program is called. The list also includes specification of anticipated responses and a list of frames to branch to in the event of a match or mismatch of student response. Provision is made for the sequence of display, i.e., pauses in the audio channel and turning on and off the visual display.

A simulator for the LTL language has been written on the Laboratory's IBM 360/67 computer. Its purpose is to allow LTL authors to test their LTL programs with the interactive aids available on the 67. The author may use the terminal keyboard as the LTS-1 keyboard, stepping through his program and the student responses in a variety of modes. Several options are available. In SINGLE-STEP, the system types out each line of LTL program as it reaches and executes it, indicating the branches and actions. For each line executed, the user must type a number indicating how many lines are desired for the next step. In EDIT, the user may access any line of his program and alter it. In EXECUTE, the user may type in a good LTL line and have it executed. Finally, in QUERY, the user may ascertain the contents of any of the registers or buffers as well as the state of the LTS terminal such as the picture and sound. The simulator has been nearly completely debugged, and a short manual will soon be available for authors. The programs for use in the Keesler Trial are being checked out on this facility.

C. The Keesler Computer System

The computer is a Digital Equipment Corporation PDP-8/I with 8000, 12-bit words of core. It will independently support five LTS prototype terminals, i.e., five students each on different lesson materials. Initially, the author logic specifications (lists) are recorded on magnetic tape so that they may be corrected readily during the debugging phase. Two tape drives are available – one for author logic, and another for data recording. Messages to the student monitor and student records are printed on a teletype machine.

D. The Keesler Software System

The software system to support the Keesler Trial is shown schematically in Fig. 1. The time-sharing monitor selects a user buffer area and a logic area as current. It then invokes the Logic Fetch routine, the Tape Recording routine, and the Display Fetch routine. If any of these are ready to process information, they search the current user buffer area for service requests, process them, and return to the monitor. The monitor then calls the LTL processor which uses the current buffer and current logic to process a single LTL instruction step, and passes control back to the monitor. The monitor then chooses a new user buffer area and logic area as current, and so on.

While all this is occurring, the Interrupt Handler may take control on interrupts from the timer, terminals, and teletype. The Interrupt Handler is activated only to give memory information to the TTY routine, the Display Fetch routine, or the buffer area. The LTL programs are contained in a read-only file; the requisite read-write program registers are provided in each User Work Area.

The first version of the system will be complete except that it will not support dynamic loading of author logic. Most of the PDP-8/I and LTL programs have been coded, and about half have undergone preliminary checkout.

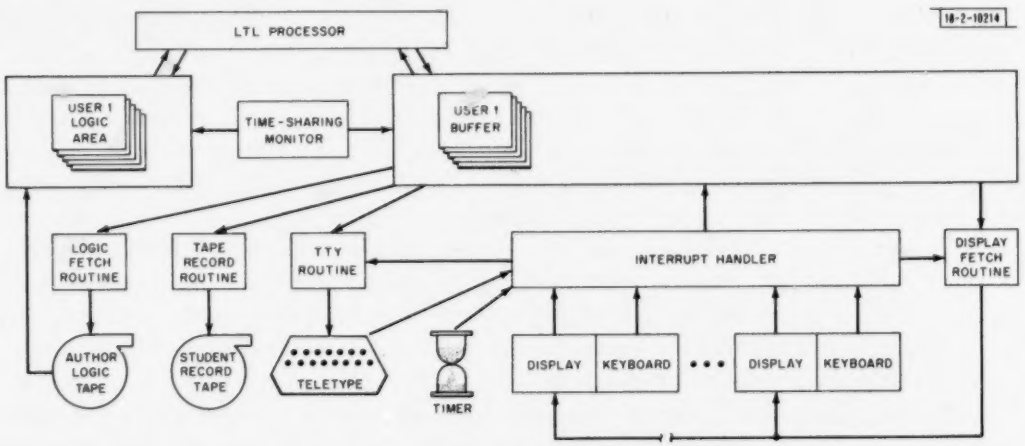

Fig. 1. Schematic diagram of Keesler Trial software system.

II. HARDWARE DEVELOPMENT

A. LTS-3 Terminal

Design was completed of modifications necessary to convert the Image Systems, Inc. Model 201 CARD Reader into the LTS-3 audio-visual student terminal. Changes include the addition of an audio reader, addition of projection optics for this reader, modification of the film gate to provide positive clamping at both audio and visual projection positions, modification of the visual projection optics to eliminate interference with the audio pattern, addition of film-referenced vernier x-y table position control to provide the more precise fiche positioning required for audio reading, removal and relocation of electrical and mechanical components, revision of the x-y table command ladder network to accommodate the 4-by-6 frame LTS-3 fiche format, and numerous changes in switching provisions to permit function command and fiche and frame selection by the digital computer. In addition, design was completed of a console to house the reader and its associated electronics and light sources.

The new audio reader design for operation at 120 rpm features a DC torque motor for radial positioning and a hysteresis synchronous motor for rotating the flywheel assembly, which carries the audio and track sensor assembly and its rack and pinion radial drive. Particular attention was paid to the rotary drive mechanism in order to insure smooth and quiet operation.

Modifications to the prototype LTS-3 audio-visual reader are essentially accomplished. A complete prototype student console is expected to be ready for system testing during October 1971.

B. LTS-3 Terminal/Computer Interface

During the past quarter, the first of five LTS-3 terminal interface links with the PDP-8/I computer was completed and successfully checked out with an Image Systems, Inc. CARD Reader and console terminal keyboard. Computer-controlled operation was demonstrated by means of a new CARD Reader cycling/scan test program which performs the same cycling and scanning operation described previously,* with the exception that the new program has no limitation on the number of microfiche selectable nor the number of frames scanned. The number of cards to be scanned may be selected at the TTY keyboard while the frame scan rate is controlled at the computer switch register. A separate diagnostic program was written to exercise the terminal keyboard/computer interface links. A time-of-day (TOD) clock interface with the computer and a diagnostic program for testing the interface was also completed during the past quarter. As presently planned, a Model L12 Chronolog digital TOD clock will be installed with the LTS-3 system at Keesler AFB. During system operation, TOD information will be used by the computer for record-keeping functions such as magnetic-tape headers and TTY printouts.

C. Author's Audio-Recording Facility

The author's audio-recording facility shown in Fig. 2 permits an author to automatically random access, record, and play back individual audio segments on magnetic tape corresponding to microfiche audio frames. The completed magnetic tape is then used as input to the master film-recording system described in the last Quarterly Technical Summary (15 June 1971). The system consists of: a two-track magnetic-tape recorder, with one track used for voice plus pause-control data and the other track used for prerecorded segment markers; a tape controller

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* Educational Technology Program, Quarterly Technical Summary, Lincoln Laboratory, M.I.T. (15 June 1971), Sec. II-E, DDC AD-728211.

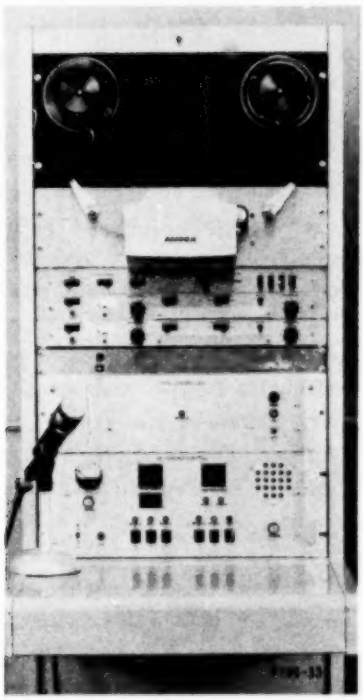

Fig. 2. LTS-3 audio-recording facility.

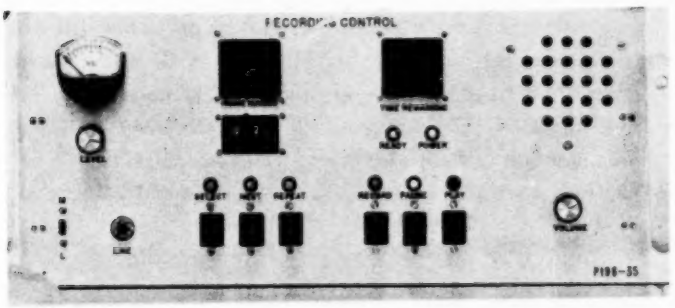

Fig. 3. Control panel: audio-recording facility.

which controls the random-access selection by detecting the prerecorded segment markers; and an author's recording controller which enables an author, via a control panel shown in Fig. 3, to select one of 40 segments, record voice and pause data, and then play back the voice and detect the pause data by means of a self-contained LTS-3 audio processor.

D. LTS-3 Master Microfiche

A special-purpose step-and-repeat camera was procured during this quarter, and will be operational during October 1971. This camera system will be used to produce 4 × 6-inch microfiche masters containing 24 audio/graphic instructional frames.

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During this quarter, the design of the LTS-3 Terminal System was completed and construction of a prototype unit was begun. A simulator for the Lincoln Terminal Language has been written on the Laboratory's IBM 360/67 computer and is being used to check out programs for the field tests at Keesler Air Force Base. Approximately 75 percent of the lesson material for these operations has been completed.

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